

Click here for  
[DISCLAIMER](#)

Document starts on next page



# **OMSAPC**

## **Advisory Circular**

**SUBJECT: Assigned Deterioration Factors for 1984 Model Year  
Light-Duty Trucks and Heavy-Duty Engines**

### **I. Purpose**

The purpose of this advisory circular (A/C) is to supplement A/C No. 51B by providing updated assigned deterioration factors (d.f.'s) for eligible categories of vehicles and engines. These d.f.'s reflect durability procedures for 1984 model year light-duty trucks and heavy-duty engines. Light-duty vehicle assigned d.f.'s are unchanged from A/C No. 51B.

### **II. Background**

A. On January 21, 1980, September 25, 1980, and October 13, 1981, EPA published rules governing certification requirements for 1984 model year light-duty trucks and heavy-duty engines. Those regulations introduced new useful life definitions, an idle CO standard, and new durability procedures with multiplicative d.f.'s for heavy-duty engines. On January 12, 1983 EPA published additional final regulations governing light-duty trucks and heavy-duty engines. These new rules modified the previously existing regulations and provided new certification options for 1984 model year light-duty trucks and heavy-duty engines. These new rules:

1. Permit new optional useful life definitions;
2. Permit new optional test procedures;
3. Specify an idle CO standard; and
4. Specify a heavy-duty gasoline engine evaporative loss standard.

These regulations permit manufacturers to establish their own useful life definition for their vehicles or engines subject to some minimums. Because useful life may not be the same for all engine families it is necessary for EPA to develop assigned

d.f. s which are usable with a variety of useful life end-point definitions. In addition, the potential for catalyst equipped heavy-duty gasoline engines requires assigned d.f.'s particular to their anticipated rate of deterioration.

B. This A/C establishes new assigned d.f.'s as functions of mileage for:

1. Heavy-Duty Gasoline Engines: HC, CO, NOx, evaporative loss, and idle CO (with separate HC and CO d.f. functions for catalyst and non-catalyst heavy-duty gasoline engines);

2. Heavy-Duty Diesel Engines: HC, CO, NOx, and smoke.

3. Gasoline-Fueled Light-Duty Trucks: HC, CO, NOx, evaporative loss, and idle CO.

4. Diesel Light-Duty Trucks: HC, CO, NOx and particulates.

C. The assigned d.f.'s contained in this A/C were developed as follows:

1. Heavy-Duty Gasoline Fueled Engines

a. Non-Catalyst: The HC, CO, and NOx d.f.'s were derived from the additive d.f.'s in A/C No. 51B, converted to mileage functions. The idle CO d.f. is based on the average heavy-duty durability engine deterioration (from the EPA data base) plus a 15 percent safety factor. The evaporative loss d.f. is based on the EPA light-duty vehicle and truck data base.

b. Catalyst: NOx, idle CO, and evaporative loss d.f.'s were assumed to be identical to the non-catalyst d.f.'s as derived in Section II.C.1.a, above.

Because there is no extant certification data for catalyst equipped heavy-duty gasoline engines, HC and CO d.f.'s are based on a catalyst deterioration model which uses the average light-duty vehicle and light-duty truck oxidation catalyst d.f. modified for:

(1) Higher catalyst poisoning due to higher (than light duty) fuel consumption and oil consumption.

(2) Higher heavy-duty gasoline engines catalyst heat loads.



(3) Higher heavy-duty gasoline engines catalyst volumes and additional active catalytic sites.

(4) Catalyst cooling measures anticipated.

## 2. Heavy-Duty Diesel Engines

The heavy-duty diesel engine assigned d.f.'s are based on the additive d.f.'s contained in A/C No. 51B converted to mileage functions.

## 3. Light-Duty Trucks

The light-duty truck assigned d.f.'s are based on A/C No. 51B with the exception of idle CO. The idle CO derivation is described in Section II.C.1.a, above.

D. The assigned d.f.'s contained in this A/C are not the average d.f. values anticipated for light-duty trucks or heavy-duty engines. Rather, these assigned d.f.'s have built-in safety margins. These safety margins permit EPA to have increased confidence that the vehicles and engines certified with these d.f.'s will not exceed the applicable emission standards during their useful life.

## III. Applicability

This A/C is effective for 1984 model year light-duty trucks and heavy-duty engines.

## IV. Eligibility

The eligibility requirements are unchanged from A/C No. 51B, Section IV.

## V. Deterioration Factors

In 1984, manufacturers may have the option to certify using various useful life/test procedure/standards combinations. The available options are treated separately below.

Deterioration factors should be calculated to four decimal precision and then rounded to one decimal place in accordance with the Rounding Off Procedure specified in ASTM E-29-67.



A. 1984 Model Year Gasoline-Fueled Heavy-Duty Engines

If an eligible manufacturer elects to use EPA assigned d.f.'s, the appropriate d.f.'s are a function of the certification option which is selected.

1. If the manufacturer chooses to certify for 1984 using the option which permits the use of 1983 procedures and standards, the additive d.f.'s for HC, CO, and NOx contained in A/C No. 51B, Attachment II apply. An assigned idle CO d.f. is unnecessary because this certification option does not require idle CO compliance for the 1984 model year.

2. If a manufacturer chooses to certify using the 1984 standards and the half-life useful life option, additive d.f.'s for HC, CO, and NOx from A/C No. 51B apply. This certification option requires an idle CO d.f. which is to be found in Attachment I of this A/C.

3. If the manufacturer chooses any other certification option, the heavy-duty engine assigned d.f.'s are contained in Attachment I of this A/C.

B. 1984 Model Year Heavy-Duty Diesel Engines

1. For manufacturers certifying using either:

- a. the 1983 test procedures and standards or,
- b. the 1984 standards and half-life useful life durability option,

the assigned d.f.'s are contained in A/C No. 51B, Attachment II.

2. For manufacturers using other available certification options the assigned d.f.'s are contained in Attachment I of this A/C.

C. 1984 Light-Duty Truck

1. For manufacturers certifying using the half-life useful life option, the assigned d.f.'s for HC, CO, NOx, and evaporative loss are contained in A/C No. 51B, Attachment II. The assigned d.f. for idle CO is contained in Attachment I of this A/C.

2. For manufacturers certifying using any other certification option, the assigned d.f.'s are contained in Attachment I of this A/C.



VI. Other Provisions

A. A manufacturer which chooses to use assigned d.f.'s outlined in A/C No. 51B or in this supplement must make a request, in writing, to:

Chief, Certification Branch  
U.S. Environmental Protection Agency  
2565 Plymouth Road  
Ann Arbor, Michigan 48105

Each request should state which of the eligibility criteria are applicable and the applicable projected sales.

B. Acceptance of EPA-assigned d.f.'s does not relieve the manufacturer of any responsibility to comply with other motor vehicle emission control requirements, including the requirements for testing of emission-data vehicles or engines, recommending reasonable maintenance to the ultimate purchaser, warranting of emission control system, labeling, etc.

Director, Office of Mobile Sources

Attachments

## Attachment I

### Additional Deterioration Factors for Heavy-Duty Engines and Light-Duty Trucks

#### I. Light-Duty Truck

The light-duty truck (LDT) assigned deterioration factors (d.f.'s) in A/C No. 51B have been converted to functions of the useful life end-point,  $f$  (in miles). The appropriate d.f. is found by inserting the useful life end-point value into the equations below and calculating the analogous d.f. For example, a non-catalyst LDT with a useful life of 65,000 miles would use an assigned HC d.f. of 1.4,  $(1 + [6.0 \times 10^{-6}] [65,000])$ .

##### A. D.F. Functions for LDT (without Catalyst)

[MULTIPLICATIVE]

$$\text{HC D.F.}_{\text{final}} = 1 + (6.0 \times 10^{-6}) (f)$$

$$\text{CO D.F.}_{\text{final}} = 1 + (4.0 \times 10^{-6}) (f)$$

$$\text{NOx D.F.}_{\text{final}} = 1.0$$

$$\text{Idle CO D.F.}_{\text{final}} = 1.15 + (8.41 \times 10^{-6}) (f - 4000)$$

[ADDITIVE]

$$\text{Evap Loss D.F.}_{\text{final}} = 0.0$$

##### B. D.F. Functions for LDT with Oxidation Catalyst

[MULTIPLICATIVE]

$$\text{HC D.F.}_{\text{final}} = 1 + (6.0 \times 10^{-6}) (f)$$

$$\text{CO D.F.}_{\text{final}} = 1 + (4.0 \times 10^{-6}) (f)$$

$$\text{NOx D.F.}_{\text{final}} = 1.0$$

$$\text{Idle CO D.F.}_{\text{final}} = 1.15 + (8.41 \times 10^{-6}) (f - 4000)$$

[ADDITIVE]

$$\text{Evap Loss D.F.}_{\text{final}} = 0.0$$

C. D.F. Functions for LDT with Three-Way Catalyst

[MULTIPLICATIVE]

HD D.F.final =  $1 + (6.0 \times 10^{-6}) (f)$   
CO D.F.final =  $1 + (4.0 \times 10^{-6}) (f)$   
NOx D.F.final =  $1 + (2.0 \times 10^{-6}) (f)$   
Idle CO D.F.final =  $1.15 + (8.41 \times 10^{-6}) (f-4000)$

[ADDITIVE]

Evap Loss D.F.final = 0.0

D. Diesel LDT

D.F.'s for Diesel LDT

[MULTIPLICATIVE]

HC D.F.final = 1.0  
CO D.F.final =  $1 + (4.0 \times 10^{-6}) (f)$   
NOx D.F.final = 1.0  
Particulate D.F.final =  $1 + (4.0 \times 10^{-6}) (f)$

II. Heavy Duty Gasoline Engine (HDGE)

A. Non-Catalyst

The HDGE non-catalyst assigned d.f.'s are the additive factors in A/C No. 51B converted to be functions of the useful life end-point, f (in miles). The factors listed below apply to non-catalyst HDGE's that certify in the 1984 (and later) model year using a transient test cycle and assigned d.f.'s.

D.F. Functions for Non-Catalyst HDGE

[MULTIPLICATIVE]

HC D.F.final =  $1.15 + (8.85 \times 10^{-8}) (f-4000)$   
CO D.F.final =  $1.15 + (2.91 \times 10^{-6}) (f-4000)$   
NOx D.F.final =  $1.15 + (8.54 \times 10^{-7}) (f-4000)$   
Idle CO D.F.final =  $1.15 + (8.41 \times 10^{-6}) (f-4000)$

[ADDITIVE]

Evap Loss D.F.final = 0.0



## B. Catalyst equipped

The HDGE's catalyst assigned d.f. function derivations are described in the body of A/C No. 51B-1.

### D.F. Functions for Catalyst Equipped HDGE

[MULTIPLICATIVE]

$$\begin{aligned}\text{HC D.F.}_{\text{final}} &= 1.0 + (7.97 \times 10^{-6}) (f) \\ \text{CO D.F.}_{\text{final}} &= 1.0 + (5.10 \times 10^{-6}) (f) \\ \text{NOx D.F.}_{\text{final}} &= 1.15 + (8.54 \times 10^{-7}) (f-4000) \\ \text{Idle CO D.F.}_{\text{final}} &= 1.15 + (8.41 \times 10^{-6}) (f-4000)\end{aligned}$$

[ADDITIVE]

$$\text{Evap Loss D.F.}_{\text{final}} = 0.0$$

## III. Heavy-Duty Diesel Engine (HDDE)

The HDDE assigned d.f.'s are the additive d.r.'s contained in A/C No. 51B converted to functions of the useful life end-point, f (in miles). These assigned d.f.'s are for engine families which certify using durability definitions other than half-life useful life. For engines certifying using the half-life useful life durability definition, the additive d.f.'s in A/C No. 51B, Attachment II, apply.

### D.F. Functions For HDDE

[MULTIPLICATIVE]

$$\begin{aligned}\text{HC D.F.}_{\text{final}} &= 1.15 + (1.10 \times 10^{-6}) (f-4000) \\ \text{CO D.F.}_{\text{final}} &= 1.15 + (1.53 \times 10^{-6}) (f-4000) \\ \text{NOx D.F.}_{\text{final}} &= 1.15 + (3.67 \times 10^{-7}) (f-4000)\end{aligned}$$

[ADDITIVE]

Smoke:

$$\begin{aligned}\text{Acceleration D.F.}_{\text{final}} &= (1.04 \times 10^{-5}) (f-4000) \\ \text{Peak D.F.}_{\text{final}} &= (1.51 \times 10^{-5}) (f-4000) \\ \text{Lug D.F.}_{\text{final}} &= (8.44 \times 10^{-6}) (f-4000)\end{aligned}$$

Note: The HC, CO, NOx, particulate, and idle CO d.f.'s are multiplicative. The evaporative loss and smoke d.r.'s are additive.